

What is claimed is:

(1) A system for supplying air to a fuel cell within a vehicle, said system comprising:

a fuel tank which stores pressurized gas;

5 a first conduit system which selectively and fluidly couples said fuel tank to said fuel cell, effective to allow said pressurized gas to be selectively communicated to said fuel cell;

an expander which is disposed within said first
10 conduit system and which is selectively and rotatably driven by said pressurized gas, effective to lower the pressure of said gas which is communicated to said fuel cell;

a second conduit system which selectively and
15 fluidly couples said fuel cell to a source of air, effective to allow said air to be selectively communicated to said fuel cell; and

a compressor which is disposed within said second conduit system and which is operatively coupled to and
20 rotatably driven by said expander, said compressor being effective to compress said air which is communicated to said fuel cell.

(2) The system of claim 1 further comprising a pressure regulator which is operatively disposed within said first
25 conduit system and which controls the pressure of the gas that is communicated to said fuel cell.

(3) The system of claim 2 further comprising a bypass valve which is effective to cause said pressurized gas to selectively bypass said expander.

(4) The system of claim 3 further comprising:

5 at least one sensor that is effective to measure at least one vehicle operating attribute and to generate a signal representing said measured vehicle operating attribute; and

10 a controller which is communicatively coupled to said bypass valve and to said at least one sensor, said controller being effective to receive said signal and to selectively actuate said bypass valve based upon the value of said signal, thereby selectively causing said hydrogen gas to bypass said expander.

15 (5) The system of claim 4 further comprising:

 wherein said controller is further communicatively coupled to and selectively controls the operation of said pressure regulator.

20 (6) The system of claim 5 further comprising a second pressure regulator which is operatively disposed within said second conduit system and which controls the pressure of said air which is communicated to said fuel cell.

(7) The system of claim 4 further comprising:

25 a secondary compressor which is selectively and fluidly coupled to said fuel cell and to said source of

air, and which is communicatively connected to said controller;

wherein said controller is effective to selectively activate said secondary compressor when said bypass valve
5 is activated, effective to provide pressurized air to said fuel cell.

(8) A system for supplying pressurized hydrogen gas and air to a fuel cell within a vehicle, said system comprising:

10 a fuel tank which stores said pressurized hydrogen gas;

a first conduit system which selectively and fluidly couples said fuel tank to said fuel cell, effective to allow said pressurized hydrogen gas to be selectively
15 communicated to said fuel cell;

an expander which is disposed within said first conduit system and which is selectively and rotatably driven by said pressurized hydrogen gas, effective to lower the pressure of said hydrogen gas which is
20 communicated to said fuel cell;

a bypass valve which is disposed within said first conduit system and which is effective to cause said pressurized hydrogen gas to selectively bypass said expander;

25 a second conduit system which selectively and fluidly couples said fuel cell to a source of air,

effective to allow said air to be selectively communicated to said fuel cell;

a compressor which is disposed within said second conduit system and which is mechanically coupled to and
5 rotatably driven by said expander, said compressor being effective to compress said air which is communicated to said fuel cell;

a secondary source of pressurized air which is selectively connected to said fuel cell; and

10 a controller which is communicatively connected to said bypass valve and to said secondary source of pressurized air, which selectively actuates said bypass valve, effective to cause said pressurized hydrogen gas to bypass said expander, and which selectively connects
15 said secondary source of pressurized air to said fuel cell when said pressurized hydrogen gas bypasses said expander.

(9) The system of claim 8 further comprising:

a plurality of sensors which are effective to
20 measure vehicle operating attributes and to generate signals representing said measured vehicle operating attributes; and

wherein said controller is communicatively coupled to said plurality of sensors and is effective to receive
25 said signals and to selectively actuate said bypass valve based upon the value of said signals.

(10) The system of claim 9 wherein said plurality of sensors comprises:

a pressure sensor which is effective to measure a pressure of said hydrogen in a certain location in said first conduit system, and to generate a first signal
5 representing said measured pressure value.

(11) The system of claim 10 further comprising:

a pressure regulator which is operatively disposed within said first conduit system and which controls the
10 pressure of the hydrogen gas that is communicated to said fuel cell;

wherein said controller is communicatively coupled to said pressure regulator and controls the operation of said pressure regulator based upon said measured pressure
15 value.

(12) The system of claim 9 wherein said plurality of sensors comprises a fuel sensor which is adapted to estimate the amount of pressurized hydrogen gas remaining in said fuel tank.

20 (13) The system of claim 9 wherein said expander comprises a turbine.

(14) The system of claim 9 wherein said compressor comprises a turbine.

(15) A method for delivering pressurized gas and air to a
25 fuel cell, said method comprising the steps of:

storing said pressurized gas within a container;

providing a first conduit system for transferring
said pressurized gas from said container to said fuel
cell;

providing a second conduit system for transferring
5 air to said fuel cell;

providing an expander;

providing a compressor;

operatively disposing said expander within said
first conduit system;

10 operatively disposing said compressor within said
second conduit system;

operatively connecting said expander to said
compressor; and

channeling said pressurized gas through said
15 expander, effective to rotatably drive said expander and
said compressor, thereby reducing the pressure of said
gas that is transferred to said fuel cell and increasing
the pressure of said air that is transferred to said fuel
cell.

20 (16) The method of claim 15 wherein said expander is
mechanically linked to said compressor.

(17) The method of claim 15 wherein said expander
comprises a turbine.

(18) The method of claim 15 wherein said compressor
25 comprises a turbine.

(19) The method of claim 15 further comprising the steps

of:

providing a first pressure regulator;

disposing said first pressure regulator within said first conduit system; and

5 controlling the pressure of said gas that is communicated to said fuel cell by use of said first pressure regulator.

(20) The method of claim 15 further comprising the steps of:

10 providing a secondary source of pressurized air; selectively causing said pressurized gas to bypass said expander; and

coupling said secondary source of pressurized air to said fuel cell when said pressurized gas bypasses said
15 expander.